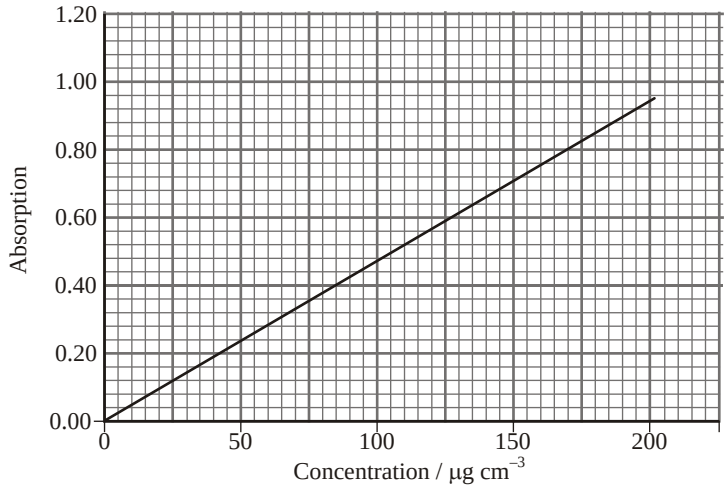
TAD05 – A1-A6 IB Practice

Name……

1. (a) State the main use of atomic absorption spectroscopy (AAS).

(1)

(b) Ore samples may be analyzed for iron using AAS. An ore sample was prepared in acid and diluted to 1 part in 10. The diluted solution gave an absorbance reading of 0.80. Determine the concentration of iron in the sample in mg cm^{-3}.



(2)

(c) Describe the use of each of the following components of the AA spectrophotometer.
Atomizer

Monochromatic light source

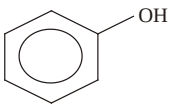
(2)
(Total 5 marks)

2. Identify **two** effects of the absorption of infrared radiation on the bonds in a molecule of carbon dioxide. Explain why an oxygen molecule does not absorb infrared radiation.

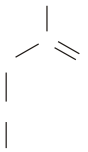
(Total 3 marks)

3. (a) Each of the infrared absorptions A, B and C is produced by one of the compounds I, II and III. Deduce which compound is responsible for each absorption, and identify the bond causing the absorption.

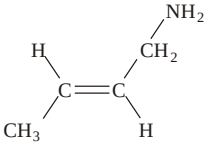
I



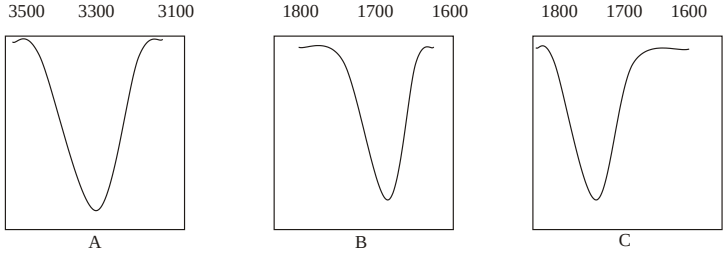
II



III



wavenumbers in cm^{-1}



Absorption	Compound	Bond
A		
B		
C		

(5)

(b) Identify which of the absorptions, A, B or C, indicates the greatest amount of energy, giving a reason for you choice.

(2)
(Total 7 marks)

4. Identify **one** analytical technique, different in each case, that can be used to obtain the following information:

Information	Analytical technique
Isotopic composition of an element	
Functional groups present in an organic compound	
Concentration of Fe^{3+} ions in industrial waste waters	

(Total 3 marks)

5. Identify **one** analytical technique, different in each case, which can be used to obtain the following information about a molecule.

Information	Analytical technique
Number of different hydrogen environments	
Types of functional group	
Molecular mass	

(Total 2 marks)

6. For each of the following compounds indicate the number of signals, and relative intensity and multiplicity of each signal in its NMR spectrum.

CH_3NH_2 $(CH_3)_2C=CH_2$ $CH_3CHClCH_3$ $CH_3CH_2COOCH_2CH_3$ $CH_3CH_2COC(CH_3)_3$

7. For each of the following compounds indicate the number of signals, and relative intensity and multiplicity of each signal in its NMR spectrum.

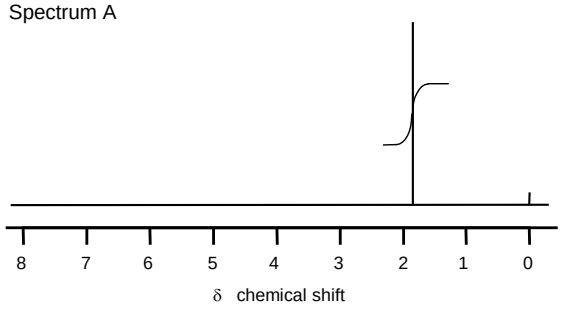
CH_3COCH_3 $CH_3CH=CH_2$ $CH_2BrCHBrCH_3$ $CH_3CH_2COOCH_2CH_3$

8. a) For each compound, predict the number of signals, and relative intensity and multiplicity of each signal.

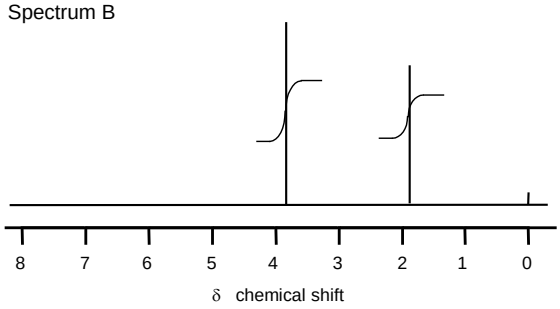
CH_3CH_2I $(CH_3)_3CBr$ CH_3COCH_2OH $(CH_3)_3COH$ $CH_2ClCHCl_2$ $(CH_2Br)_2CBrCH_3$ $(CH_3)_2CBrCH_2Br$

b) Work out which spectrum belongs to which compound.

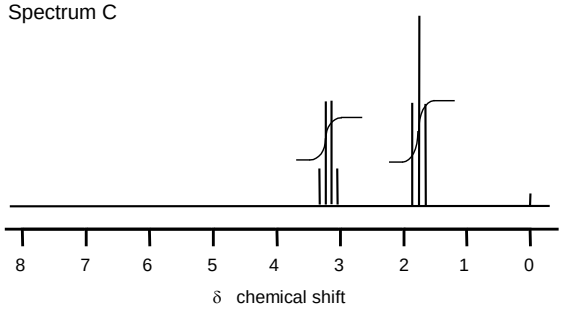
Spectrum A



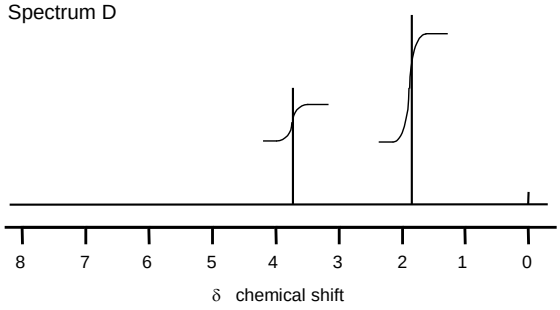
Spectrum B



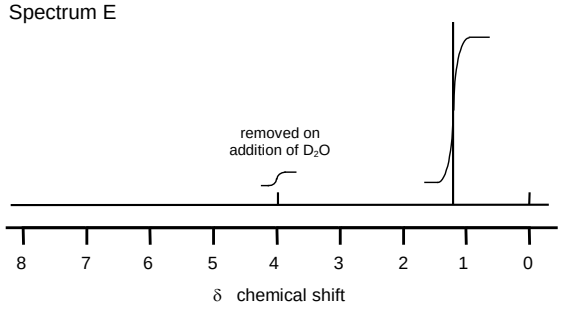
Spectrum C



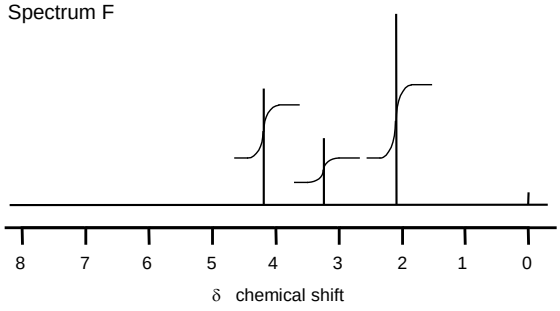
Spectrum D



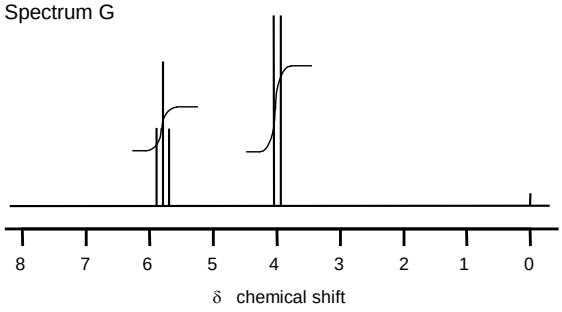
Spectrum E



Spectrum F



Spectrum G



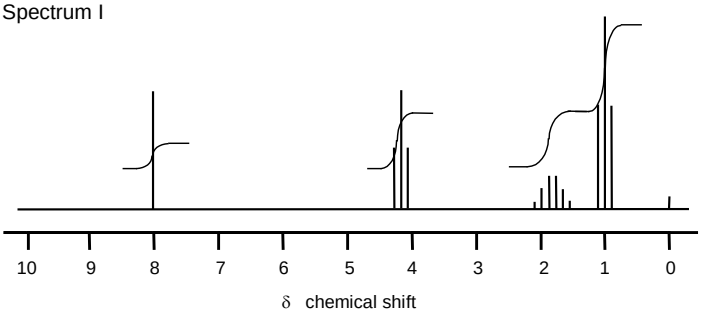
9. The spectra of three isomers of $C_4H_8O_2$ are shown.

a) Draw the structural formulae of all the isomers of $C_4H_8O_2$.

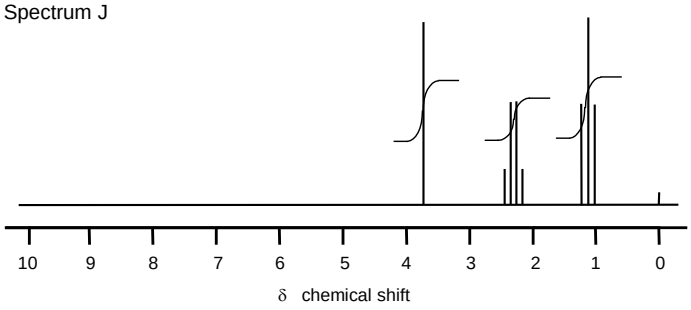
b) Indicate the number of signals, and relative intensity and multiplicity of each signal for each isomer.

c) Deduce which spectrum belongs to which isomer.

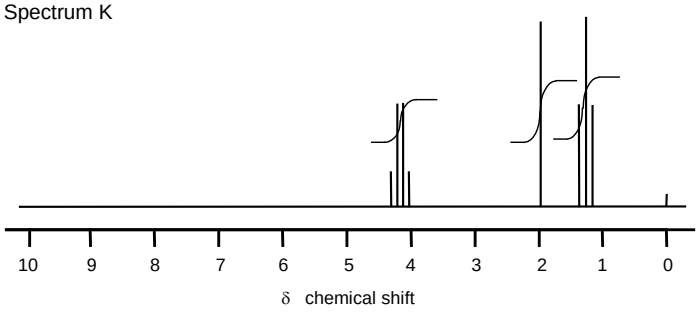
Spectrum I



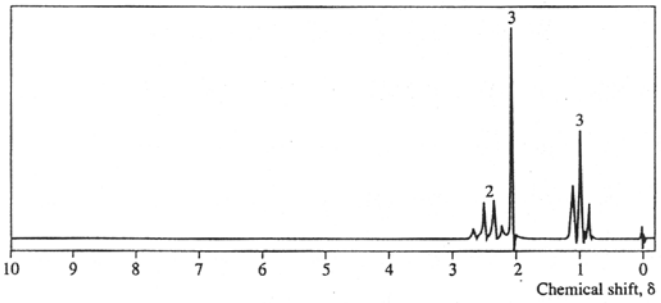
Spectrum J



Spectrum K



10. A compound has the formula C_4H_8O. The two most significant peaks in the mass spectrum of the compound are at 57 and at 43. Using this information and the NMR spectrum below, identify the compound and explain clearly your reasoning (including a full interpretation of the NMR and mass spectrum).

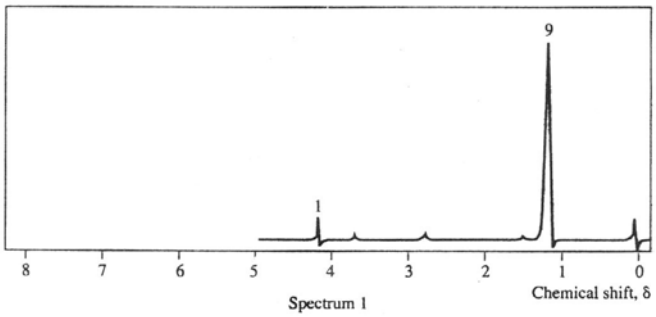


11. The spectra of three isomers of $C_4H_{10}O$ are shown. This formula is consistent with both alcohols and ethers (compounds with a C-O-C linkage).

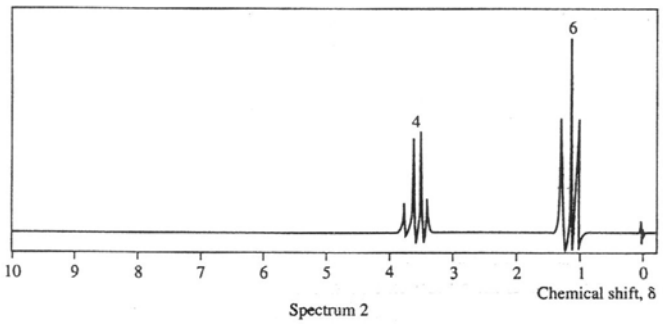
a) Draw the structural formulae of all the isomers of $C_4H_{10}O$ (there are seven in all, four alcohols and three ethers).

b) Indicate the number of signals, and relative intensity and multiplicity of each signal for each isomer.

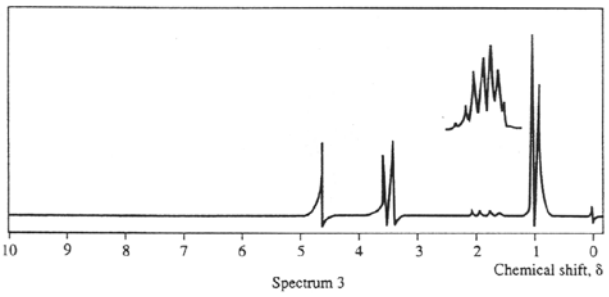
d) Deduce which spectrum belongs to which isomer.



Spectrum 1

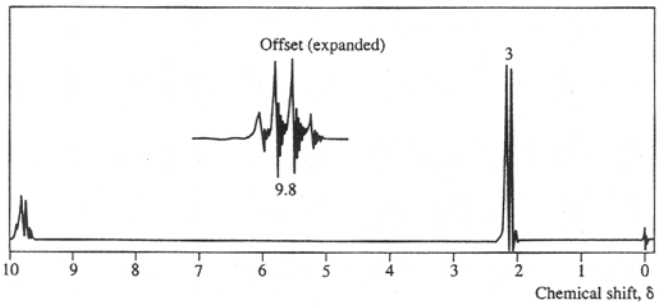


Spectrum 2

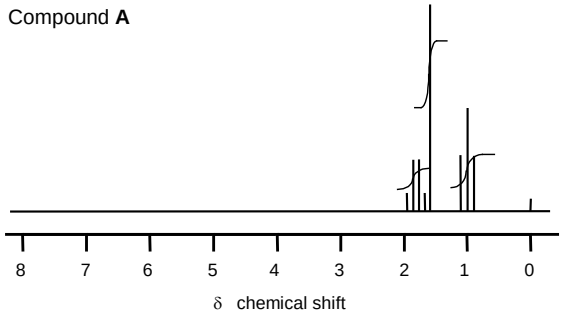


Spectrum 3

12. A compound is found to have composition by mass 54.5% C, 9.1% H and 36.4% O. The peak with the greatest *m/z* (*m/e*) value in the mass spectrum of the compound is at 44. Using this information and the NMR spectrum below, identify the compound and explain clearly your reasoning (including a full interpretation of the NMR).



13. Compound **A** was analyzed and found to contain 39.8 % carbon, 7.3 % hydrogen and 52.9 % bromine. Its mass spectrum showed two molecular ion peaks at m/z 149 and m/z 151, with roughly equal intensity. The NMR spectrum of **A** is shown below.



Reaction of **A** with potassium hydroxide formed a mixture of **B** and **C**. The NMR spectra of **B** and **C** are shown below. Reaction of **B** with HBr formed mainly **A** and some **D**. Reaction of **C** with HBr formed mainly **A** and some **E**. Deduce the structures of compounds **A** to **E**.